Prevalence and Associated Factors with Low Birth Weight in Kersa District: Based on Data from Health and Demographic Surveillances System in 2014, Eastern Ethiopia

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Abstract

Background: Globally, as of 2010, an estimated 43.3 million babies were born with low birth weight. This accounts to 36% of all births in low and middle income countries. Low birth weight is the main risk factor for neonatal and infant mortality. In many developing countries including Ethiopia, as most women give birth at home, an accurate estimate of the problem is not known. Hence, the main objective of this analysis is to determine the prevalence and factors associated with low birth weight in Kersa District, Eastern Ethiopia; it is based on the data from longitudinal surveillance.

Methods: This study used longitudinal data of all the pregnant women and birth outcome from Kersa Health and Demographic Surveillance System who were followed from December 2013 to November 2014. During this period2116 live birth were registered and the weights of 1088 newborn weight were measured within 72 hours. Bivariate and multivariate analyses were used to identify the factors associated with low birth weight. Crude and Adjusted Odds Ratio with 95% confidence interval was reported with significance level of P<5%.

Results: The prevalence of low birth weight was 21.9% (95%CI: 17.1%-26.7%). Rural residence (AOR 5.49; 95% CI: 2.61-11.54), labor work (AOR 4.29; 95% CI: 1.42-12.92), middle wealth index(AOR 1.87; 95%CI; 1.22-2.86), institutional delivery (AOR 1.44; 95%CI: 1.05-1.97) and not using bed net (AOR 1.59; 95%CI: 1.17-2.16) were predictors of low birth weight.

Conclusion: The magnitude of low birth weight was high. Rural residence, labor work, middle wealth index, institutional delivery and not using bed net were the predictors of low birth weight. Risk focused health education during antenatal follow up, along with quality and accessible antenatal care, should be stressed.

Key work: *Birth weight, low birth weight, Kersa HDSS, Haramaya University*

How to cite: Shore, H., Shunu, A., Musa, A., and Assefa, N. 2018. Prevalence and Associated Factors with Low Birth Weight in Kersa District: Based on Data from Health and Demographic Surveillances System in 2014, Eastern Ethiopia. *East African Journal of Health and Biomedical Sciences,* Volume 2(1): 36-44.

Introduction

Low Birth Weight (LBW) is defined as birth weight less than 2500 grams (World Health Organization, 1992, WHO, 2004b).It is one of the poor pregnancy outcomes that has caught the attention of World Health Organization. In 2010, national and regional estimates of 184 countries showed that 43.3 million low birth weight infants were born each year, which account 36% of all births in low or middle income countries (Lee *et al*., 2013).

Low birth weight is not only the major determinant of perinatal and infant survival, but also lifelong developmental disabilities and illnesses (WHO, 2004a).It is the leading risk factor for neonatal and infant mortality in developing countries (McCormick, 1985; Kramer, 2005). Neonates and infants with low birth weightsuffer from extremely high rates of morbidity and mortality from infectious disease, underweight, stunting or wasting that begin in the neonatal period through childhood(Shrimpton R., 2003). Roughly every ten seconds, an infant dies from conditions that are related to low birth weight in developing countries(UNICEF and WHO, 2004; Kramer, 2005).

Low birth weight babies usually need more hospital care, and there is a continuous fear and doubt over future health outcomes (Shore and Shore, 2009). Many of the neonatal mortalities take place among LBW babies and those who do survive suffer poor growth and higher rate of morbidity due to communicable diseases during early years of life, in addition to impaired cognitive and behavioral development. The expenditure of care for babies with

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LBW is very high (WHO, 1984). Despite the efforts made to decrease the occurrence by at least one third between 2000 and2010, LBW remains a main public health challenge particularly in sub-Saharan African countries (WHO, 2011).

According to EDHS 2011 report, in Ethiopia, infant mortality rate was 59 per 1000 live births, neonatal mortality was 37 deaths per 1000 live births, and post neonatal mortality was 22 deaths per 1000 live births(Central Statistical Agency [Ethiopia] and ICF International, 2012). Further analysis of EDHS 2011 data revealed that very small or smaller than average babies five years preceding the survey in Oromia Region was 26 percent (Betew and Muluneh, 2014). But in a community based study in Tigrai Region the prevalence of low birth weight in urban was 9.9% and in rural 6.3 percent (Teklehaimanot *et al.*, 2014). Two studies in Southwestern Ethiopia showed that the incidence of low birth weight was 17.9 percent (Wado *et al.*, 2014), and 22.5 percent (Tema, 2006). Here, it's clearly evident that the magnitude of low birth weight varies across different settings and the majority of these studies relied on snapshot survey and/limited hospital set up.

Literatures showed that environment (Nobile *et al.*, 2007; Kayode *et al.*, 2014; Tema, 2006; Wado *et al.*, 2014; and Demelash *et al.*, 2015); maternal characteristics (Alemu and Umeta, 2015; Nobile *et al.*, 2007; Ngwira and Stanley, 2015; Betew and Muluneh, 2014; de Souza Buriol *et al.* 2016; Assefa *et al.*, 2015; Ahmed and Jaakkola, 2007; Ondine. *et al.*, 2013; Ronda *et al.*, 2009; Feng *et al.*, 2010; Kate, 2010; Taha *et al.*, 2012; Eva *et al.*, 2007; Viengsakhone *et al.*, 2010; and Padhi *et al.*, 2015), and fetal factors (Nobile *et al.*, 2007; Domple *et al.*, 2016; Dahlui Dahlui1 *et al.*, 2016; Ngwira and Stanley, 2015; and Pingili *et al.*, 2007) are the factors that significantly associated with the low birth weight.

The estimates of low birth weight predominantly relied on hospital based cross-sectional studies and the majority of them did not have adequate power (Megabiaw *et al.*, 2012; Tema, 2006; and Teklehaimanot *et al.*, 2014), and the results cannot be inferred to the community setup. The other study (Assefa *et al.*, 2012) could not address the current status.

Therefore, there is great need for accurate community based estimate of low birth weight, since great majority of births take place at home. Hence, this analysis aimed at assessing the prevalence and factors associated with low birth weight at the community level that are amenable to change so that low birth weight related morbidity and mortality can be dealt with proactively in comprehensive way.

Materials and Methods

Study Setting

This study used data from Kersa Health and Demographic Surveillance System (Kersa HDSS), which was established in September 2007 in Kersa District, Eastern part of Ethiopia, with the objective of following demographic changes including death, birth, migration, morbidity, reproductive health, marital status change and health seeking behavior (Assefa *et al.*, 2015).

Study Design and Stud Population

The analysis used data based on follow up of all pregnant women and their birth outcome registered during a period between December 2013, and November 2014. During this period, 2116 live births were registered and 1088 of them who had their birth weight taken within 72 hours were included in the analysis.

Data Extraction and Variables

Data of pregnant women and their birth outcomes that were collected from December 1, 2013 to November 30, 2014 were extracted from HRS-2 database. For the analysis, weight less than 2500gm considered low birth weight and coded 1, and birth weight greater than 2500g considered normal and coded as 0. Wealth index was used (Assefa. *et al.*, 2012, Arokiasamy and Pradhan, 2011) for economic status of the family. Maternal nutritional status was assessed using mid-upper arm circumference; MUAC< l23cm considered as malnourished and coded 1, whereas ≥23cm normal. MUAC doesn't vary much during pregnancy and is therefore an appropriate measure of nutritional status than BMI or weight (Mohanty *et al.*, 2006). The other variables extracted from the database were maternal socio-demographic characteristics, ANC follow up status, number of parity, sex of newborn, and mosquito bed net use status.

Data Analysis

The data were analyzed using SPSS Version 23 statistical software package after thorough data cleaning. Results were presented by texts, and frequency distribution along with summary statistics; mean and standard deviation were computed to describe the study participants. Bivariate analysis (chi-square) was used to identify the factors associated with

low birth weight. Binomial Logistic regression analysis was carried out to identify the factors independently associated with low birth weight and to control possible confounders. All the variables in Univariate analysis were entered into multiple logistic regression. Crude and adjusted odds ratio with 95% confidence interval was calculated. The level of significance was declared at P-value less than 5%.

Ethical Consideration

Ethical clearance was obtained during the establishment of the longitudinal project from the Institutional Health Research Ethic Review committee (IHRERC), Ethiopian Public Health Association (EPHA) ethical review board, and the American Center for Disease Control (CDC) Atlanta. Participants were informed regarding the objective of the research and informed verbal consent was secured during the commencement of the project, baseline and subsequent data collection. The right of participants was respected during the interview and information confidentiality kept anonymous.

Results

Prevalence of Low Birth Weight

Measurements of 1088 neonates/mothers were involved in this analysis. The mean birth weight was 3014.8±550.7gms. The overall prevalence of low birth weight was 21.9% (95% CL, 17.1%-26.7%). Two third (66.6%) of all the live births had normal birth weight, whereas 11.5 %(125) were more than 4000gms.

The percentage of low birth weight was higher among the women aged less than 20 year and in age 20 to 29 years than in mothers aged 30 to 49 years. More low birth weight were also observed among the women who were rural resident, illiterate, engaged in labor work and delivered at health institution than their counterparts. More low birth weight was observed in parity 1-2 and 3-4, had no ANC follow up, MUAC less than 23cm, not using Bed Nets, and female sex. Univariate analysis showed that Low birth weight is significantly associated with residence, wealth index and not using bed nets (P<0.05) (Table 1).

Factors Associated with Low Birth Weight in Kersa District

In multivariate logistic analysis, place of residence, maternal occupation, wealth, place of delivery and not using bed nets were significantly associated with low birth weight. The model showed that the odds of being rural resident (AOR 5.49; 95% CI: 2.61-11.54); maternal engagement in labor work (AOR 4.29; 95% CI: 1.42-12.92);middle wealth index(AOR 1.87; 95%CI; 1.22-2.86); institutional delivery (AOR 1.44; 95%CI: 1.05-1.97), and not using bed net (AOR 1.59; 95%CI: 1.17-2.16) were significantly with low birth weight (Table 2).

Discussion

The analysis showed that LBW was high (21.9%) in the study area. This reveals that significant proportion of babies born in current study area were at higher risk of developing life threatening acute complications and lifelong developmental disabilities and morbidities. This finding was consistent with the one in Jimma zone, South West Ethiopia (Tema, 2006), where the prevalence was 22.5%. It was higher than the incidence of low birth in southwestern Ethiopia, which was 17.9 percent (Wado et al., 2014). The observed variation could be explained by the variation of the study set up which results in variation in study population since the later study conducted in the health facilities including referral hospital. Additionally, this finding was higher than the finding in Kenya, which was 12.3 percent (Muchemi et al., 2015).

In this study, rural residence was significantly associated with low birth weight and this was consistent with the study finding in Southwestern Ethiopia (Wado et al., 2014) and Southeast Ethiopia (Demelash et al., 2015), Ghana (Kayode et al., 2014), and Italy (Nobile et al., 2007), which showed that rural residence was strong predictor of LBW. However, other study conducted Southwest Ethiopia (Tema, 2006) showed that urban residency strongly predict low birth weight. This could be explained by the fact that in urban residence community deprived in terms of job opportunities, social amenities and infrastructures, which carries an increased risk of low birth weight.

In this study, it was found that maternal engagement in labor work was a strong predictor of low birth weight. This finding was similar with the findings of several studies conducted in U.S.A, which reported that low birth weight rate was higher among those in the standing group compared with those in the sedentary and active groups (Teitelman et al., 1990; Ondine et al., 2013; Nobile et al., 2007; and Mahmoodi et al., 2015). And it was also consistent with the findings from similar studies conducted in several other countries (Ronda et al., 2009; Ahmed and Jaakkola, 2007; Silva et al., 1998), in which low births increased among women working during pregnancy.

Table 1: Distribution of Low Birth Weight among Babies born in Kersa Health and Demographic Surveillance, Eastern Ethiopia, 2014

Characteristics	**Total N=1088**	**<2500gm (%)**	**≥2500gm (%)**	**P-value**
Maternal age in year				
Less than 20	179	22.3	77.7	0.53
20-29	524	23.1	76.9	
30-49	385	20.0	80.0	
Place of residence				
Urban	123	11.8	88.2	0.002
Rural	965	23.3	76.7	
Maternal education				
Literate	374	21.1	78.9	0.66
Illiterate	714	22.3	77.7	
Maternal occupation				
Housewife	759	21.2	78.8	
Farmer	140	22.9	77.1	0.69
Student	167	22.2	77.8	
Laborer	22	31.8	68.2	
Wealth Index				
Low	461	25.2	74.8	0.021
Middle	405	21.3	78.7	
High	222	50.0	50.0	
Place of delivery				
Home	598	20.1	79.9)	0.11
Health institution	490	24.1	75.9)	
Parity				
1-2	548	22.6	77.4	
3-4	238	22.7	77.3	0.61
5+	302	19.9	80.1	
Attended ANC				
Yes	376	21.3	78.7	0.73
No	712	22.2	77.8	
MUAC of mother				
Less than 23cm	340	22.6	77.4	0.68
Greater or 23cm	748	17.5	82.5	
Gender of newborn				
Female	522	22.8	77.2	0.68
Male	566	21.0	79.0	
Bed nets use				
Yes	570	19.1	80.9	0.022
No	518	24.9	75.1	

Note: ANC, Antenatal Care, MUAC; Mid-Upper Arm Circumference

Table 2: Factors Associated with Low Birth Weight among Babies born in Kersa Health and Demographic Surveillance, Eastern Ethiopia, 2014

Covariates	Birth weight		COR, 95%CI	AOR, 95% CI
	<2500gm	≥2500gm		
Maternal age in year				
Less than 20	40	139	1.15(0.75-1.77)	1.11(0.60-2.06)
20-29	121	403	1.20(0.87-1.66)	1.13(0.73-1.75)
30-49	77	308	1	1
Residence				
Urban	13	110	1	1
Rural	225	740	2.57(1.42-4.47)*	5.49(2.62-11.54)*
Maternal education				
Literate	79	295	1	1
Illiterate	159	555	1.07(0.79-1.45)	1.05(0.68-1.61)
Maternal occupation				
Housewife	162	597	1	1
Farmer	32	108	1.09(0.71-1.68)	1.03(0.64-1.66)
Student	37	130	1.72(0.69-4.30)	1.05(0.61-1.81)
Laborer	7	15	1.05(0.70-1.57)	4.29(1.42-12.92)*
Wealth Index				
Low	98	363	1.31(0.86-1.98)	1.28(0.83-1.97)
Middle	102	303	1.63(1.08-2.47)*	1.87(1.22-2.86)*
High	38	184	1	1
Place of delivery				
Home	120	478	1	1
Health institution	118	372	1.26(0.95-1.69)	1.44(1.05-1.97)*
Parity				
1-2	124	424	1.18(0.83-1.67)	1.16(0.69-1.96)
3-4	54	184	1.18(0.78-1.79)	1.22(0.76-1.97)
5+	60	242	1	1
Attended ANC				
Yes	80	296	1	1
No	158	554	0.95(0.78-1.43)	0.95(0.68-1.32)
MUAC of mother				
Less than 23cm	77	263	1.06(0.78-1.43)	0.91(0.66-1.27)
Greater or 23cm	161	587	1	1
Sex of newborn				
Female	119	403	1.11(0.83-1.48)	1.17(0.87-1.58)
Male	119	447	1	1
Use bed nets				
Yes	109	461	1	1
No	129	389	1.40(1.05-1.87)*	1.59(1.17-2.16)*

Note: COR, crude Odds Ratio; AOR: Adjusted Odds Ratio; CI: Confidence Interval, 1=reference category, *=<0.05; ANC, Antenatal care; MUAC, Mid-Upper Arm Circumference.

This can be explained by increased energy demand and work related stress that, especially in the second trimester of pregnancy is associated with increased level of corticotropin, which can affect LBW directly through passing the placenta or indirectly through maternal vascular function and reduction in uterine-placenta blood flow(Cunningham *et al.*, 2010).

We observed that middle wealth index was significantly associated with low birth weight. A similar observation was reported from a study in Ethiopia (Betew and Muluneh, 2014), U.S.A (Fang Fang *et al.*, 1999), Vietnam(Huong *et al.*, 2013) and Ghana (Manyeh *et al.*, 2016). This could be due to poor nutrition and poor access to medical care. A lower birth weight resulting from poverty has a long lasting consequence, which ultimately contribute to the reproduction of inequality over generations. Low-income may limit access to health necessities, such as an adequate diet. For families experiencing food insecurity, even small, short-term variations in income can influence mothers' nutritional intake (Kate, 2010), which in turn affect birth weight.

It was found that institutional delivery was a predictor of low birth weight. This can be explained by the fact that many of mothers in this study (65.4%) and 51.6% of the women who gave birth in health institution did not attend ANC during pregnancy, which is the significant predictor of low birth weight(Assefa *et al.*, 2012; Ngwira and Stanley, 2015; Adane *et al.*, 2014; Demelash *et al.*, 2015; Nimi *et al.*, 2016; Ntui *et al.*, 2014; and Alemu and Umeta, 2015). The surveys from 69 low-income and middle-income countries showed that the chance of low birth weight reduce by 3.82% with at least one ANC follow up (Kuhnt and Vollmer, 2017). Women who attend ANC follow up receive advice on balanced diet and the need for proper nutrition during pregnancy, and management and preventive intervention of maternal anemia that association with low birth weight (Rahmati *et al.*, 2017). However, further research is needed to better understand the link between institutional delivery and low birth weight.

In our study, not using bed net was significantly associated with low birth weight when compared with those mothers used during pregnancy. This was consistent with the finding of meta-analysis of 32 national cross-sectional data sets in Africa and other studies (Eisele *et al.*, 2012; Feng *et al.*, 2010; and Lengeler, 2004). It was also observed that not using Bed Net increased the risk of peripheral malaria, which was associated with low birth weight(De-Beaudrap *et al.*, 2013; Luxemburger *et al.*, 2001) because malaria parasite induce placenta inflammatory response that predispose fetal growth restriction and maternal anemia(Stephen *et al.*, 2007).

Conclusion and Recommendations

The magnitude of LBW was significant in this report. The significant predictors of LBW were rural residence, labor work, middle wealth index, institutional delivery and not using bed nets. This is significant since LBW is associated with neonatal and infant morbidity and mortality and related hospital visit and admission. To prevent acute life threatening complication, developmental disabilities and low birth weight related chronic morbidities, multi-faceted proactive approaches such as risk focused health education during antenatal follow up, along with quality and accessible antenatal care should be implemented to prevent low birth weight in order to prevent related complications. Additionally, efforts should also be made to reaching out pregnant women in rural and those engaged in physical work to provide them with appropriate services.

Acknowledgments

The authors would like to thank Kersa Health and Demographic Surveillance System (Kersa HDSS), Haramaya University, CDC, and EPHA. We would like to thank Ms. Mahlet Mekonnen for proper data extraction.

Conflict of interest

We declare that we do not have any financial and non-financial competing interests

Authors' Contributions

HS developed the concept, designed the analysis, performed the statistical analysis and drafted the manuscript. NA set the health and demographic surveillance system, supervises quality data and led the system and contributed to designing, the analysis, interpreting of findings and revised the manuscript. AS and AM designed the analysis, performed the statistical analysis and drafted the manuscript. All authors critically reviewed the manuscript for important intellectual content and approved the manuscript.

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